

What is claimed is;

1. A driving assist system for a vehicle, comprising:  
a state recognition device that detects a vehicle  
5 condition and a traveling environment of a subject vehicle;  
a future state prediction device that calculates a  
current degree of proximity to a preceding vehicle and/or an  
extent of influence on the subject vehicle due to future changes  
in surrounding environment to predict future driving  
10 conditions, based on detection results of the state recognition  
device; and  
a risk potential calculating device that calculates risk  
potential around the subject vehicle based on the future  
driving conditions predicted by the future state prediction  
15 device and a driver's intentions.
2. A driving assist system for a vehicle according to claim  
1, further comprising:  
a reaction force calculating device that calculates an  
20 operation reaction force to be generated in a vehicle operating  
unit according to the risk potential calculated by the risk  
potential calculating device; and  
a reaction force generating device that generates the  
operation reaction force calculated by the reaction force  
25 calculating device in the vehicle operating unit.

3. A driving assist system for a vehicle according to claim 2, wherein:

the vehicle operating unit is an accelerator pedal;

5 the reaction force calculating device calculates the operation reaction force to be generated in the accelerator pedal; and

the reaction force generating device generates the operation reaction force in the accelerator pedal.

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4. A driving assist system for a vehicle according to claim 1, further comprising:

a warning system that outputs a warning according to the risk potential calculated by the risk potential calculating  
15 device.

5. A driving assist system for a vehicle according to claim 1, wherein:

20 the risk potential calculating device estimates the driver's intentions from acceleration and deceleration of the subject vehicle to calculate the risk potential.

6. A driving assist system for a vehicle according to claim 1, wherein:

25 the risk potential calculating device estimates the

driver's intentions from acceleration and deceleration of the subject vehicle and the preceding vehicle to calculate the risk potential.

- 5    7.    A driving assist system for a vehicle according to claim 1, wherein:

the state recognition device detects the vehicle condition and the traveling environment of the subject vehicle including a subject vehicle speed, a preceding vehicle speed,  
10    and a distance between the subject vehicle and the preceding vehicle;

the future state prediction device calculates a time headway based on one of a set of the distance between vehicles and the subject vehicle speed and a set of the distance between  
15    vehicles and the preceding vehicle speed as the extent of influence due to changes in the surrounding environment; and

the risk potential calculating device calculates the risk potential based on a reciprocal of the time headway.

- 20    8.    A driving assist system for a vehicle according to claim 7, wherein:

the risk potential calculating device calculates the risk potential based on a linear sum of the reciprocal of the time headway and a time differentiated value of the reciprocal  
25    of the time headway.

9. A driving assist system for a vehicle according to claim 7, wherein:

the risk potential calculating device calculates based  
5 on a linear sum of the reciprocal of the time headway, a time differentiated value of the reciprocal of the time headway, and a twice differentiated value of the reciprocal of the time headway.

10 10. A driving assist system for a vehicle according to claim 1, wherein:

the state recognition device detects the vehicle  
condition and the traveling environment of the subject vehicle  
including a subject vehicle speed, a preceding vehicle speed,  
15 and a distance between the subject vehicle and the preceding vehicle;

the future state prediction device calculates time to  
contact based on a relative speed and the distance between  
vehicles detected by the state recognition device as the degree  
20 of proximity to the preceding vehicle; and

the risk potential calculating device calculates the  
risk potential based on a reciprocal of the time to contact.

11. A driving assist system for a vehicle according to claim  
25 10, wherein:

the risk potential calculating device calculates the risk potential based on a linear sum of the reciprocal of the time to contact, and a time integrated value of the reciprocal of the time to contact.

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12. A driving assist system for a vehicle according to claim 10, wherein:

the risk potential calculating device calculates the risk potential based on a linear sum of the reciprocal of the  
10 time to contact, a time integrated value of the reciprocal of the time to contact, and a time differentiated value of the reciprocal of the time to contact.

13. A driving assist system for a vehicle, comprising:  
15 a state recognition means for detecting a vehicle condition and a traveling environment of a subject vehicle;  
a future state prediction means for calculating a current degree of proximity to a preceding vehicle and/or an extent of influence on the subject vehicle due to future changes in  
20 surrounding environment to predict future driving conditions, based on detection results of the state recognition means; and

a risk potential calculating means for calculating risk potential around the subject vehicle based on the future  
25 driving conditions predicted by the future state prediction

means and a driver's intentions.

14. A vehicle, comprising:

a vehicle operating unit;

5 a state recognition device that detects a vehicle condition and a traveling environment of a subject vehicle;

a future state prediction device that calculates a current degree of proximity to a preceding vehicle and/or an extent of influence on the subject vehicle due to future changes  
10 in surrounding environment to predict future driving conditions, based on detection results of the state recognition device;

a risk potential calculating device that calculates risk potential around the subject vehicle based on the future  
15 driving conditions predicted by the future state prediction device and a driver's intentions;

a reaction force calculating device that calculates an operation reaction force to be generated in the vehicle operating unit according to the risk potential calculated by  
20 the risk potential calculating device; and

a reaction force generating device that generates the operation reaction force calculated by the reaction force calculating device in the vehicle operating unit.

25 15. A method for calculating risk potential, comprising:

detecting a vehicle condition and a traveling  
environment of a subject vehicle;

predicting future driving conditions by calculating a  
current degree of proximity to a preceding vehicle and/or an  
5 extent of influence on the subject vehicle due to future changes  
in surrounding environment based on the vehicle conditions  
and the traveling environment having been detected; and

calculating the risk potential around the subject  
vehicle based on the predicted future driving conditions and  
10 a driver's intentions.

16. A method for calculating risk potential according to  
claim 15, wherein:

a time headway is calculated based on one of a set of  
15 a distance between the subject vehicle and the preceding  
vehicle and a subject vehicle speed and a set of the distance  
between vehicles and a preceding vehicle speed as the extent  
of influence due to changes in the surrounding environment;  
and

20 the risk potential is calculated based on a linear sum  
of a reciprocal of the time headway and a time differentiated  
value of the reciprocal of the time headway.

17. A method for calculating risk potential according to  
25 claim 15, wherein:

a time headway is calculated based on one of a set of a distance between the subject vehicle and the preceding vehicle and a subject vehicle speed and a set of the distance between vehicles and a preceding vehicle speed as the extent  
5 of influence due to changes in the surrounding environment;  
and

the risk potential is calculated based on a linear sum of a reciprocal of the time headway, a time differentiated value of the reciprocal of the time headway, and a twice  
10 differentiated value of the reciprocal of the time headway.

18. A method for calculating risk potential according to claim 15, wherein:

time to contact is calculated based on a relative speed  
15 and a distance between the subject vehicle and the preceding vehicle as the degree of proximity to the preceding vehicle;  
and

the risk potential is calculated based on a linear sum of a reciprocal of the time to contact and a time integrated  
20 value of the reciprocal of the time to contact.

19. A method for calculating risk potential according to claim 15, wherein:

time to contact is calculated based on a relative speed  
25 and a distance between the subject vehicle and the preceding



vehicle as the degree of proximity to the preceding vehicle;  
and

the risk potential is calculated based on a linear sum  
of a reciprocal of the time to contact, a time integrated value  
5 of the reciprocal of the time to contact, and a time  
differentiated value of the reciprocal of the time to contact.